WHEN *CHANOS CHANOS* BECAME *TSUNAMI MACCHI*: THE POST-DECEMBER 2004 SCENARIO IN THE ANDAMAN & NICOBAR ISLANDS

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The earthquake that triggered the tsunami of December 26, 2004, also caused a significant and permanent shift of the lay of the Andaman and Nicobar Islands. The northern Andaman Islands saw a lift of up to 1.5 m, while the Nicobars, in the south, subsided in places by nearly 4.75 m. This resulted in much larger damage caused by the tsunami to life and property in the Nicobar Islands even though the area and population here are much less than those in the Andamans. Huge changes were also effected to the topography of the islands and the coastal and marine ecosystems.

An intriguing set of subsequent and successive changes in the disturbed ecosystems have also started to occur, but little is being done to study or understand these. These changes, as also the continued seismic activity in the region, are important determinants that need to be kept in mind for reconstruction and rehabilitation efforts, and for future policy and development planning in these islands.

Key words: Andaman & Nicobar Islands, earthquake, tsunami, December 26, 2004, ecological changes

INTRODUCTION

The Andaman and Nicobar Islands are a chain of 572 islands, reefs and rocks in the Bay of Bengal. The total distance between the extremities is about 355 km, whereas the maximum width is 60 km. The islands are the summits of a submarine range of hills 1,120 km long that connect the Arakan Yoma of Myanmar with the Achin head of Sumatra (Anon 2003). The total area of the island chain is 8,249 sq. km[1] of which the larger and more numerous Andaman group of islands cover 6,408 sq. km, while the southern group of the Nicobars cover 1,841 sq. km (Saldanha 1989).

According to the census data, the total population of the Andaman and Nicobar Islands was 3,56,152 in 2001. Of this the population of the Andaman islands was 3,14,084 and that of the Nicobars was 42,068[2].

The Earthquake and Tsunami of December 26, 2004

The earthquake of December 26, 2004, and the tsunami that came in its wake are the greatest disaster to have hit the Andaman and Nicobar Islands in living memory (Malik and Murthy 2005). This is not surprising considering the fact that Indira Point, the southern most tip of the islands, located on Great Nicobar Island (6° 45.2' N; 93° 49.6' E), is only about 180 km from the epicentre of the earthquake that triggered the tsunami. Official figures list 3,513 people as either dead or missing and 7,992 hectares[3] as the paddy and plantation land that was affected. A total of 938 boats were fully damaged, while the number of livestock reported to have been lost in the disaster is 1,57,577 (Anon 2006; Chandi n.d.).

Disaggregation of these figures along the lines of the two island groups gives a very interesting and important picture. Of the 3,513 people reported dead and missing, only 64 are from the Andaman group of islands, the remaining 3,449 being from various islands in the Nicobar group. Of the total agricultural and paddy land destroyed, 76% is from the Nicobar group. Similarly, 80% of livestock loss was in the Nicobars. The latest figures for houses being constructed for the tsunami affected also indicate a similar trend. Of the 9,797 permanent houses being constructed, 7,001, or 71%, are in the Nicobars (Table 1).

It is evident that the impact in the Nicobar group of islands was much worse than that in the Andaman Islands. So, while the Nicobar Islands account for only 22% and 12% of the area and population, respectively, of the entire chain of islands, 98% of the deaths and 76% of loss of agricultural land occurred here. The damage caused is inversely proportional to the area and population of the two groups and strikingly so (Table 2).

While the tsunami was directly responsible for most of the damage, a more fundamental explanation lies in the earthquake that caused the tsunami. While the tectonic movements triggered by the earthquake catalysed the tsunami, they also caused a huge and permanent shift in the lay of the

[1] It is important to bear in mind that these are pre-December 2004 figures. The latest figures are not available.

[2] The estimated total population for the island group in 2009 was 475,000.

[3]A subsequent statistic from the A&N administration indicates that the total agricultural land lost was 10,837 hectares, of which 9,107 hectares was said to be plantation land and 1,730 hectares was paddy land. The island-wise break-up for this figure is not available.

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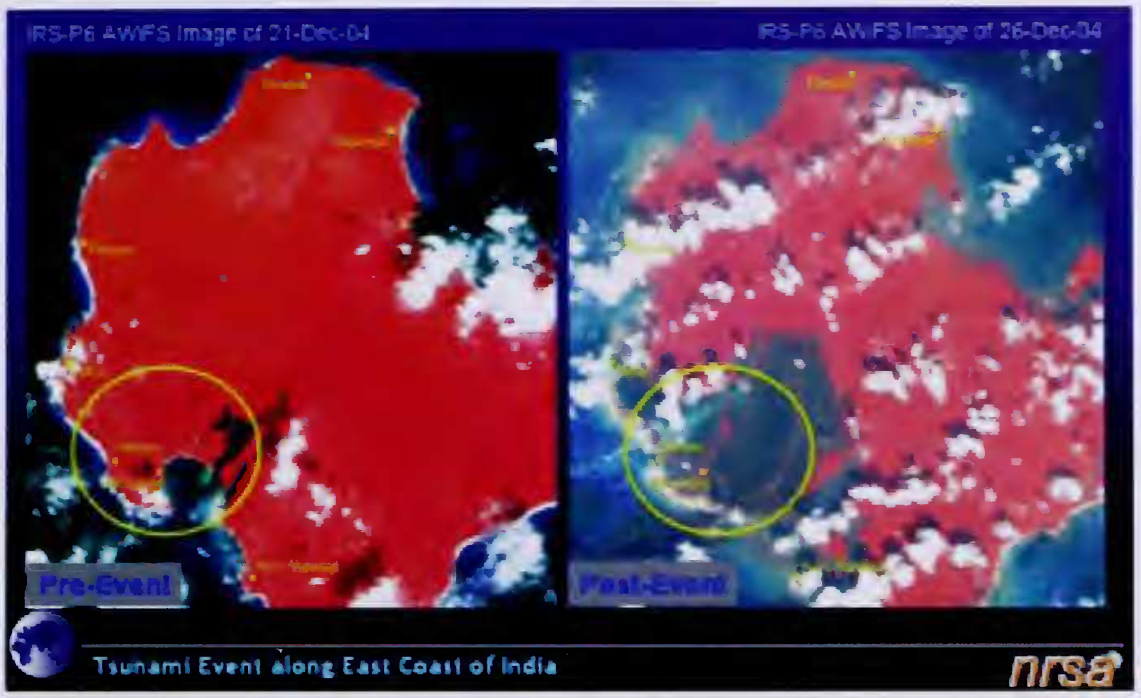

Fig. 1: Satellite images of Katchall island before (left) and after (right) the earthquake of December-2004

Table 1: Island-wise losses

	People (dead or missing)		Livestock loss		Agricultural land lost		Permanent housing		Area		Population (2001)	
	Total number	%	Total number	%	Area in hectares	%	Number	%	Sq. km	%	Number	%
Andamans	**64**	**2**	**31,521**	**20**	**1,877**	**23.5**	**2,796**	**28.6**	**6,408**	**77.68**	**3,14,084**	**88**
South Andaman			19,634		1667		823					
Little Andaman			11,165		117		1,973					
Middle Andaman			722		93							
Nicobars	**3,449**	**98**	**1,26,056**	**80**	**6,115**	**76.5**	**7,001**	**71.4**	**1841**	**22.32**	**42,068**	**12**
Car Nicobar	854		50,350		969.35		3,941					
Chowra	117		11,896		230.4		346					
Teressa			17,307		743.96		506					
Katchal	1,551		18,678		1,628.50		315					
Nancowry	378		1,440		256.57		269					
Kamorta			7,501		637.4		518					
Trinket			2,590		328.5							
Little Nicobar			2,267				111					
Great Nicobar	549		12,298		1,291.28		995					
Kondul			336									
Pilomilow			823									
Bambooka			570		29.55							
Total	**3,513**	**100**	**1,57,577**	**100**	**7,992**	**100**	**9,797**	**100**	**8,249**	**100**	**3,56,156**	**100**

Andaman and Nicobar Islands. Preliminary reports and assessments show that with a pivot figuratively and roughly located near Port Blair, the Andaman Islands, in the north, experienced a permanent uplift of 1-2 m, while there was a subsidence of up to 4 m in the Nicobar group of islands (Bilham *et al.* 2005; Malik and Murthy 2005; Ramanamurthy *et al.* 2005; Thakkar and Goyal 2006)[4] (see Web link in reference for map; also see attached maps (Figs 1 and 2) from the

[4]Also see http://cires.colorado.edu/%7ebilham/IndonesiAndaman2004_files/AndamanSRL4Mar.htm and (downloaded 10/08/2010) and http://dsc.nrsc.gov.in:14000/DSC/Tsunami/CaseStudies.jsp?state=ANDAMAN_NICOBAR%20ISLANDS# (downloaded 10/08/2010)

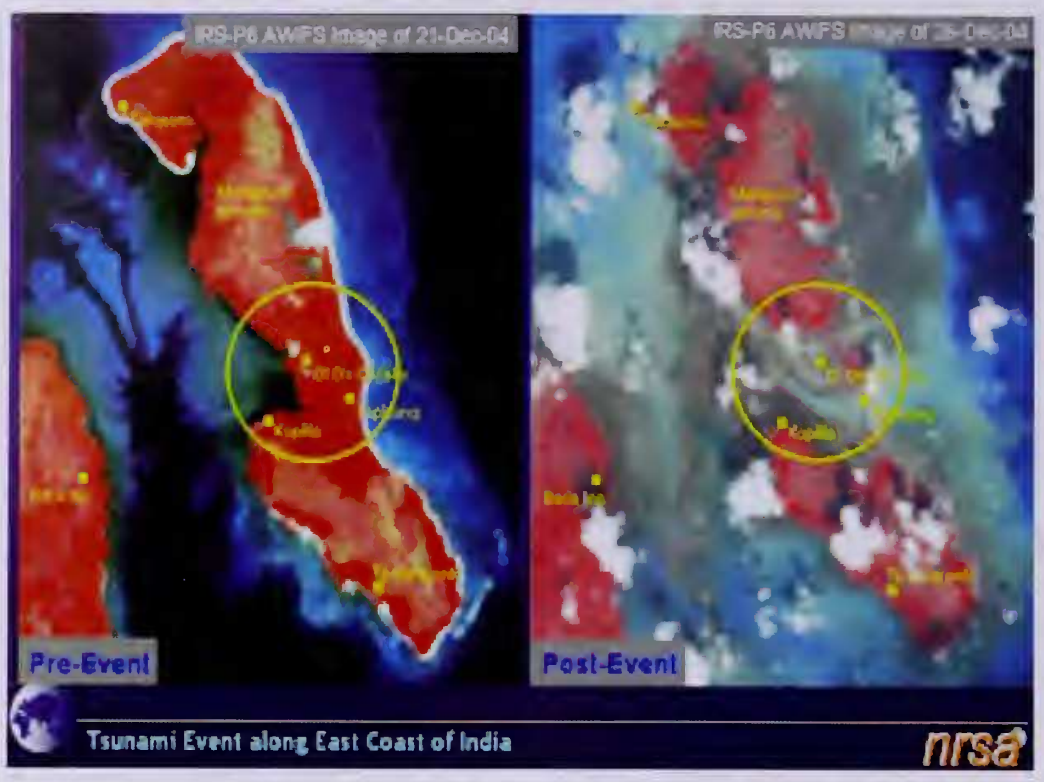

Fig. 2: Satellite images of Trinkat island before (left) and after (right) the earthquake of December-2004

National Remote Sensing Agency (NRSA)). The tide gauge at Port Blair is reported to have recorded an initial subsidence of the harbour (or rise in sea level) about 38 minutes after local shaking commenced (op. cit.). Eyewitness accounts indicate that the main shocks were felt in Port Blair around 0635 hrs IST on December 26, 2004. While this was followed almost immediately (15-20 minutes later) by the first influx of sea waves, it was around 0830 hrs, 2 hours after the main shock, that a third wave hit the shores with a velocity that caught citizens unaware (Anon 2005b).

Other reports (http://www.asce.org/files/pdf/tsunami/3-7.pdf) indicate that there was a gap of 50 minutes between the initial earthquake and the first wave of the tsunami in Port Blair. Three more waves are reported to have followed with a gap between each other of 30-35 minutes. While there is no information to indicate what may have happened in other parts of the islands, it can perhaps be assumed that the pattern everywhere was the same and, by implication of importance and significance, that the subsidence and uplift of the landmass occurred before the most powerful and damaging of the tsunami waves hit the shores of the Andaman and Nicobar Islands. The Nicobars, though spread over a smaller area and also more thinly populated, suffered much greater damage than did the Andamans as a consequence, and this is reflected in the figures of those killed during the tsunami and of agricultural and horticultural land lost.

The dominant human population in the Nicobar Islands is the Nicobari tribal community, which is essentially coastal dwelling (Singh 2006). They were therefore the most

Table 2: Island-wise losses as percentages

	Andamans (%)	Nicobars (%)	Total
Area (sq. km)	6,408 (77.68)	1,841(22.32)	8,249
Population (2001)	3,14,084 (88)	42,068 (12)	3,56,152
People (dead or missing)	64 (2)	3,449 (98)	3,513
Livestock loss	31,521 (20)	1,26,056 (80)	1,57,577
Agricultural land lost (hectares)	1,877 (23.5)	6,115 (76.5)	7,992
Permanent housing	2,796(28.6)	7,001 (71.4)	9,797

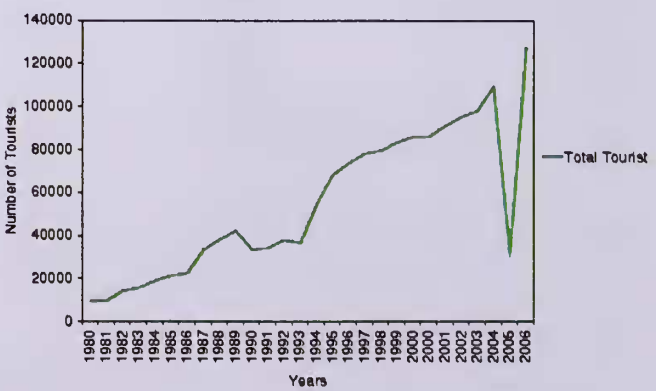

Fig. 3: Tourist arrivals in the Andaman Islands

vulnerable and in the direct route of the powerful tsunami which followed the significant subsidence that took place on account of the earthquake. Of the 3,513 people reported dead or missing, a full 2,955 were from the tribal community (Anon 2006).

ECOLOGICAL CHANGES

The Nicobar Islands

Significant changes were reported along the coastline of most of these islands. The small Megapode Island, located west of Great Nicobar, has, for instance, gone completely under (Manish Chandi, pers. comm.). Coral reefs, beaches and low lying coastal forests across the Nicobars were badly affected. The Nicobar reefs were hit due to the combination of the submergence, the resultant increase in turbidity and the physical damage caused by the tons of debris thrown back and forth by the furious waves. A survey conducted by the Zoological Survey of India reported large scale sedimentation on coral reefs around Great Nicobar Island after the tsunami. A reduction in the number of other associated coral reef fauna including nudibranchs, flat worms, alpheid and mantis shrimps, and hermit and brachyuran crabs was also reported (Alfred *et al.* 2006).

In an interesting development immediately after the tsunami, fishermen from Campbell Bay, in Great Nicobar, reported a sudden and huge increase in the catch of Milk Fish *Chanos chanos*, which was relatively rare earlier. So huge and sustained was the harvest of this particular fish that it quickly came to be called the 'tsunami *macchi*' (Anon 2005a). While the exact causes can only be speculated about, a post-tsunami ocean salinity and temperature study carried out in the islands by scientists of the National Centre for Antarctic and Ocean Research did find a considerable thermohaline variability in the upper 300 m column of ocean water and concluded that changes such as this could be expected to have a significant impact on primary production and fisheries (Luis *et al.* 2007).

Early surveys conducted by the Andaman and Nicobar Environment Team (ANET) in the Nicobars also indicated huge losses of Pandanus *Pandanus leram* and the Nypa Palm *Nypa fructicans*. The Nypa Palm in particular was wiped out almost completely from the estuarine regions of Little Nicobar and Great Nicobar islands. Significantly, both these plants are extremely important for the Nicobari community as a source of food and materials for regular use, such as for thatch for their dwellings. An effort is now being made with the help of the local communities to repopulate these islands with these very important and useful species (Chandi 2005a,b, 2006).

The permanent submergence in the Nicobars also saw the immediate and complete loss of most of the beaches here, many of which were important nesting sites for the 4 marine turtle species found here — the Giant Leatherback *Dermochelys coriacea*, the Green Sea Turtle *Chelonia mydas*, the Olive Ridley *Lepidochelys olivacea* and the Hawksbill *Eretmochelys imbricata*. This change, however, was a short-lived one, and new beaches had started to form along the altered alignment within months. Nesting turtles too were back again very soon (Murugan 2006; Chandi *et al.* 2006).

The damage to the low lying coastal areas, the coastal forests and the mangroves, however, was more permanent. Large tracts of the forests were completely destroyed, and for many months after the disaster the islands in the Nicobars could be seen encircled by an endless brown wall of dying and decaying trees. A remote sensing and GIS based study of the Central Nicobar group of islands (Nancowry, Camorta, Trinket and Katchal) by the Institute for Ocean Management at Chennai's Anna University has assessed the damage to range from 51% to 100% for mangrove ecosystems, 41% to 100% for coral reef ecosystems and 6.5% to 27% for forest ecosystems (Ramachandran *et al.* 2005).

Dr. Ravi Sankaran of the Sálim Ali Centre for Ornithology and Natural History (SACON) conducted a rapid impact assessment of the Nicobars almost immediately after the disaster. His main interest was to look at the status of the Nicobari Megapode *Megapodicus nicobariensis nicobariensis* and *M.n. abbotii*, the ground nesting endemic bird that scrapes together a mound of earth as a nest in low lying coastal forests. The submergence in the Nicobars had permanently destroyed a huge part of the bird's nesting habitat, and the study found that nearly 1,100 nesting mounds had been lost (Sankaran 2005).

A subsequent survey in early 2006 by the Wildlife Institute of India covered nearly 110 km of the coastline in 15 islands in the Nicobar group. The study estimated that only about 500 active nesting mounds of the bird had survived in the Nicobars and that the megapode population post-tsunami was less than 30% of what had been estimated during surveys conducted nearly a decade ago (Sivakumar 2006). While the bird has certainly been hit badly, the impact is not as bad as was initially feared.

Little is known, however, of the other equally vulnerable, coastal forest dwelling fauna, prominently, the Giant Robber Crab *Birgus latro*, the Reticulated Python *Python reticulatus* and the Malayan Box Turtle *Cuora amboinensis*. There is almost no idea of how these have been impacted, and there are indications that these have come worse off than the megapode.

There were initial fears, particularly in the case of the Giant Robber Crab that it might have become locally extinct in the Nicobars as it inhabits that section of the coast that was

most badly devastated – the less than 100 m wide strip of forest adjacent to the sea. There were reports however that they were being occasionally sighted and this was confirmed when four individuals – two on Camorta Island and one each on Great Nicobar and Menchal were sighted in late 2006 (Patankar 2007).

The Andamans

Areas around Port Blair also experienced permanent submergence (about 2-3 feet) and saw a fate similar to that of the Nicobars. The damage is most clearly seen in the low lying area of Sippighat, just a few kilometres outside the capital town. Mangrove marshes that had been converted to paddy fields over many years were permanently submerged and lost. A study conducted by scientists of the Port Blair based Central Agricultural Research Institute (CARI) found a severe impact on mangroves in the creeks of Sippighat, Shoal Bay, Chouldhari and Mahatma Gandhi Marine National Park at Wandoor, due to high salinity stress and permanent inundation (Dam Roy and Krishnan 2005). As in the case of Great Nicobar, this led to one dramatic, though short lived, change here. For the first few months immediately after the tsunami, Sippighat Creek became a huge production ground for the best prawns that residents of Port Blair had ever eaten (pers. obs).

Most of the other parts of Andamans, however, experienced a fate that was the opposite of that of the Nicobars and of what was seen near Port Blair. The CARI study found, for instance, that the mangrove stands of Deshbandhugram, Laxmipur, Milangram and Swarajgram, in North Andaman, remained exposed even during high tide. Sea water was not reaching the mangroves at all, and within a few months of the event they had started to wilt (Dam Roy and Krishnan 2005).

The most dramatic impact, however, was seen off the west coast of the northern part of the Andaman Islands. Huge areas of coral reefs were permanently thrust above the high tide line, destroying them within weeks. A rapid assessment of the Andamans carried out by the Andaman and Nicobar Environmental Team (ANET) 2 months after the earthquake estimated that more than 50 sq. km of coral reefs had been so exposed and killed – the largest area being nearly 25 sq. km, west and north of Interview Island (Andrews and Vaughan 2005). A similar impact was seen in parts of Indonesia too. The coral reef damage due to the tsunami was nominal in comparison to that which happened on account of the earthquake. "The most dramatic damage to Aceh reefs," says a report by Living Oceans, Reef Check and IUCN, "was also caused by the earthquakes. Hectares of reef flat at Pulau Bangkaru Island and Simeulue were uplifted to a level above the high tide mark resulting in total mortality of previously healthy and intact reefs" (Foster *et al.* 2006).

The situation for the sea turtle nesting beaches appears to have turned up a mixed bag in the islands. Flat Island, a small island on the west coast of the main Andamans, for instance, was an important sea turtle nesting site prior to the tsunami. The uplift caused by the earthquake has exposed coral reefs surrounding the island and now created a barrier to sea turtles visiting the island to nest. Some beaches such as those in Little Andaman Island are reported to have become wider, and the gradients have also become gentler due to the tectonic activity (Chandi *et al.* 2006). The ANET team also reported extensive damage to sea grass beds, something that was evident by the many weak Green Sea Turtles and dead specimens that were seen in many places during the surveys they conducted.

CONCLUSION

The islands have always been very active seismically (Rajendran *et al.* 2003), and there is evidence now that the sensitivity and activity have increased since December 2004. Nearly 20 earthquakes of a magnitude over M6 in addition to several hundred of lesser intensity have been recorded in the region after December 2004 (http://earthquake.usgs.gov/regional/world/historical_country.php#indian_ocean).

Some, such as the September 12, 2007, earthquake off the Sumatra coast of a magnitude greater than M8 on the Richter scale resulted in a tsunami warning being issued in the Andaman and Nicobar Islands as well (Raju 2007).

Increased seismic activity and the increased threat on account of this need to now be made an important aspect of policy and development planning in the islands. Similarly, the change in the topography of the islands on account of the tectonic movements caused as a result of the massive earthquake of December 26, 2004, needs to be factored in, both for the ongoing relief and rehabilitation work here and for future planning.

An important illustrative example would be the tourism industry in the islands and its aggressive promotion post-December 2004. The industry has been promoted as an important revenue earner and employment creator for people in the islands. A lot of financial resources are also being spent to encourage tourists to come to the islands, and special packages for government employees have also been created.

A study led by the NGO EQUATIONS (Anon 2008), however, shows that the contribution of the tourism industry to the economy of the islands is extremely nominal. The contribution of tourism in the islands to the Gross State Domestic Product (GSDP) has been stagnant at around 8% for the last 2 decades though tourism arrivals themselves have

grown by about 1,000%. Further, its contribution to revenue generation is also insignificant. Tourism (as in the hotels and restaurants sector) was found to employ less than 1.5% of the total main workforce of the islands, and this employment is seasonal. It is well-known that tourism is an extremely fickle industry and is affected adversely and almost immediately by other factors such as natural disasters, political strife or economic fluctuations. Figures for tourist arrivals (see Fig. 3) to the Andaman Islands provide an excellent indication of this as numbers fell to almost nil immediately after the tsunami. Creating exclusive reliance on such an industry for stimulating economic growth and employment is bound to fail.

There is an urgent need also to re-calibrate the high tide line (HTL) across the islands to allow correct implementation of the regulations related to coastal management and development. This has implications for development planning, location of construction projects, including those for tourism, and ensuring protection of the coast as per the laws and policies of the land.

As far as the ecological changes are concerned, observers (Andrews and Vaughan 2005; Sankaran 2005) have argued that no drastic interventions should be made to "correct" the situation. They have argued that no intervention would be the best intervention and the processes of nature should be allowed to take their own course.

An understanding and incorporation of these aspects should be made fundamental to dealing with the present and future situation in the A&N islands. That would be the first step towards dealing with existing and future vulnerabilities. Ignoring these and the implications is only an invitation to more trouble in the future, with potentially disastrous consequences.

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